UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Information Preferences of Engineering Educators Faced with Remote Laboratory Adoption Decisions

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Steven Walter Tuttle declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy in the Faculty of Engineering and Information Technology at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Preface

This study began with an initial interest in investigating the *quality* of remote engineering instructional laboratories. Sharability—that remote labs can be shared between institutions—is a particularly desirable quality. This type of exchange includes the presence of a provider and a consumer. One institution provides the remote lab; the other institution consumes the remote lab. Of course, it is possible that an institution may be a provider in some instances and a consumer in others. Though there are imaginable exceptions (e.g., subsidised use), this type of sharing should generally be equitable. This is not to say the exchange is necessarily 'in-kind' or lab-for-lab. There are other markers of value, including money and goodwill. When considering the relative worth of a remote lab, it is necessary is to address the matter of quality. However, quality is difficult to define and measure. Quality metrics are typically used to assess this measure of quality. These quality metrics are derived from quality criteria, which are derived from quality factors, which originate in expert opinion.

While this study is not about quality, it is an important factor when considering fair exchange for sharing. However, until such sharing is commonplace, the matter of relative lab worth is a moot point. This is not to say that remote lab quality is not of interest in and of itself, only that, until remote lab utilisation reaches some threshold, assessing quality is secondary to increasing remote lab utilisation. The realisation that utilisation is a precondition prompted a shift of attention for the present study. Although quality, to my mind, is an interesting (and more difficult) question, it is more urgent to address the matter of utilisation.

The general question then becomes: 'what are the possible mechanisms that will increase remote lab utilisation'? This study is based on the assumption that increased utilisation is desirable. Various strategies—including institutional mandate, student demand, government intervention, and/or private-sector incentives—might be employed to increase remote lab utilisation. However, as a result of discussions with colleagues, I identified one particular mechanism that would have a positive impact on remote lab utilisation. This mechanism would be for a teacher to say to students: 'you will use a remote lab if you wish to pass my subject'. More specifically, one way to attain increased remote lab utilisation would be for engineering teachers to assign remote lab activities to their students.

How, though, does one go about getting teachers to do this?

In the end, it is teachers' responsibility to decide whether to adopt a remote lab for teaching purposes. This claim is predicated on the assumptions that a remote laboratory is available for use and that the choice of laboratory mode is a decision made by a teacher (except in the case of administration-imposed requirements). To make an informed decision, teachers need information about a given remote lab to support a decision concerning whether to use it in support of teaching and learning. To address this issue, this study is based on the question: *What information about remote labs would be most helpful for engineering educators when deciding whether to use a remote lab in the context of their teaching?*

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Abstract

Remote engineering instructional laboratories have become increasingly extant since their 1996 proof-of-concept inception at Oregon State University. Numerous institutional initiatives have spurred the development and deployment of increasingly sophisticated remote labs to support engineering education. The literature has likewise burgeoned from feasibility alone to include a wide range of pertinent topics relating to matters technical, organization, and pedagogical. These labs are deployed with a presumed intention of use; yet many contemporary remote lab instantiations remain underutilized. One mechanism by which remote labs are utilized is when a teacher decides to adopt a remote laboratory for instructional purposes.

This thesis presents results from a multi-phase research project that has explored the information preferences of engineering educators faced with remote laboratory adoption decisions. From the UTAUT of Venkatesh et al, it is known that facilitating conditions are among the several contributing factors that lead to individual technology adoption decisions. Relevant information is such a contributing factor. This research has determined that engineering educators *do* have information preferences when seeking to make informed decisions regarding remote lab adoption.

A four-level general taxonomy of remote laboratory information-types was emergently generated from the literature using techniques from grounded theory. The 37 second-level taxa were preferentially ordered by a cohort of engineering educators (associated with Australian universities) using a best-worst-scaling approach. A novel methodology was created to validate the preferential ordering and investigate the applicability of the remote laboratory information-type ordering. A standard-form survey was then designed to triangulate the results and affirm several key assumptions.

Engineering educators clearly prefer information about experiments that can be conducted on a remote laboratory installation over information about the institutional income that might accrue during use. Other preferences are less clear-cut. While, for example, information about collaboration afforded by remote labs is clearly preferred over information about the remote lab location, information about teacher benefits is sometimes preferred over information about

collaboration and vice versa. Though there is a preferential ordering of information-types, the ordering is a gradation, some types are clearly preferred over others; and other types are of co-equal value; dependent on individual proclivities. What the research did reveal was that remote lab information-types most relevant to the institution (e.g. income, expense) were disdained relative to pedagogical information-types (e.g. student benefits, visualization).

The triangulation survey affirmed teacher autonomy, remote lab underutilization, and the importance of relevant information to engineering educators faced with educational technology adoption decisions.